LETTERS

Edited by **Jennifer Sills**

Instituting recruiting meritocracy in Italy

AS A HARVARD University professor who worked at the Italian Institute of Technology (IIT), it is dismaying to read L. Margottini's In Depth news article criticizing the proposed IIT-managed Human Technopole (HT) project in Milan ("Plans for new research hub get critical reception," 11 March, p. 1127). The claims that IIT is not accountable and does not follow international standards are inaccurate. I helped to design IIT's new tenure-track system, which follows open, meritocratic, international recruitment standards that are otherwise exceedingly rare in Italy. (I still have a small consulting contract with IIT.) IIT's tenure-track system offers top young scientists full intellectual and financial independence, and it holds those scientists individually accountable. Modeled according to IIT's blueprint, the HT project foresees international recruitment of about 100 new principal investigators at steady state.

This is more than rhetoric: In 2015, I helped coordinate IIT's first tenure-track recruitment for independent junior principal investigators (*1*). As with any proper search, we placed advertisements in top journals and sent targeted email solicitations to hundreds of scientists worldwide, encouraging their best young colleagues to apply. We received close to 400 applications—unprecedented by Italian standards—the vast majority from outside Italy, including many non-Italians. We assembled international search committees to review applications and interview shortlisted candidates. The winning candidates are superb young scientists qualified for faculty positions at top research universities and institutes worldwide. This experience and success in recruiting bodes well for the HT project.

IIT's international recruiting standards must be contrasted with the recruiting practices of Italian universities and public research institutes, where calls are frequently honed to fit the profile of favored local candidates, and most new researchers are not independent by any meaningful standard. Italy has thus been less competitive in recruiting and retaining top young scientific talent. Italian science would indeed benefit from increased funding, but international, meritocratic recruitment is paramount. Young scientists deserve open competition and independence in Italy; IIT and the HT project are critical steps in that direction.

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Invasive species shape evolution

IN THEIR PERSPECTIVE "Evolution in the Anthropocene" (26 February, p. 922), F. Sarrazin and J. Lecomte suggest a greater investment in securing the long-term evolutionary potential of species to safeguard biodiversity. However, evidence from biological invasions, a major feature of the Anthropocene, challenges the assumptions that evolutionary processes necessarily occur over long time scales, are constrained by human activities, or can in any way be predicted.

Invasive weedy rice has evolved from cultivated rice in fields worldwide.

PHOTO: DAVID GEALY, USDA ARS/WIKIMEDIA COMMONS

Invasive alien species pose a substantial threat to biodiversity (*1*), but they may also increase evolutionary diversification (*2*). Contemporary adaptation as a result of biological invasions highlights that evolutionary time scales can be surprisingly short. Not only can alien species evolve rapidly to changing environments despite small founder populations (*3*), but native species are known to adapt within a few generations in response to invasion (*4*).

Far from constraining the evolutionary trajectories of species, the Anthropocene may accelerate rates of evolution, given the often strong selection pressures in anthropic environments. Weedy rice has arisen multiple times in rice fields worldwide, often through parallel evolution from different cultivated rice varieties, despite the limited genetic variability in cultivated rice varieties (*5*). Even in a highly domesticated species, there might be ample genetic variation to allow subsequent evolution.

Forecasting the risk and consequences from alien species is notoriously difficult (*6*) and, similar to all life forms, their evolutionary trajectories will depend on context. For example, hybridization between native and alien species can result in new species with greater invasion potential (*7*), lead to the replacement of native species with fitter hybrids possessing novel traits (*8*), or facilitate the transfer of genes across distinct evolutionary lineages (*9*). Whether such genetic diversification brings biodiversity benefits, as some have argued (*10*), is debatable, but demonstrates that proposals to conserve the evolutionary trajectories of nonhuman species will still be guided by human perceptions of what is desired. The evolutionary implications of biological invasions are likely illustrative of other biotic pressures on biodiversity in the Anthropocene and suggest that defining operational metrics of evolutionary potential to guide conservation in a rapidly changing world will be difficult and possibly impractical.

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Response

WE AGREE WITH Hulme and Le Roux that invasive species speed up evolution. Although we did not explicitly list invasion in the spectrum of current evolutionary drivers in our Perspective, we classify it as an "alteration of interaction networks and

coevolutionary networks" likely to generate evolutionary responses. We also agree that evolution can occur on short time scales. As we advocated, evolution-focused (evocentric) conservation targets nonhuman fitness and thus considers both micro- and macroevolution.

We disagree with Hulme and Le Roux that our call for maintaining evolutionary potential equates to a call for maximizing evolutionary diversification. Evolution-focused conservation neither asks for more evolution nor states that rapid evolution will solve conservation issues. Rather, it strives for maximum evolutionary freedom: Nonhuman species should be allowed to evolve independent of humans. In that context, Hulme and Le Roux's focus on the evolutionary impact of invasive species in agrosystems, particularly weedy rice, perfectly exemplifies our argument. Weedy rice is an unexpected evolutionary consequence of domestication, at the scale of not only individual traits but plant community. The emergence of weeds, pathogens, and pests in agrosystems is largely due to directional selective pressures of agricultural practices [e.g., (*1*)], standardization of monocultures (*2*), and creation of vacant niches through homogenized and simplified environments.

In the same way, the examples cited by Hulme and Le Roux (*3*, *4*) are unexpected outputs from purely short-term anthropocentric efforts to increase human well-being. Alien and invasive species are only one element of the process by which human activities drive nonhuman evolution. Evolution-focused conservation considers not only the proximate causes of evolutionary processes, but also the ultimate ones. This is central to discriminate "anthropogenic" from "nonanthropogenic" evolution. We cannot act against aliens without acknowledging our responsibility in their emergence.

Finally, we agree that defining operational metrics of evolutionary potential is highly challenging for theory and biometry. We believe that it is better to address this challenge than to ignore it.

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TECHNICAL COMMENT ABSTRACTS

Comment on "Slow adaptation in the face of rapid warming leads to collapse of the Gulf of Maine cod fishery"

Michael C. Palmer, Jonathan J. Deroba, Christopher M. Legault, Elizabeth N. Brooks

Pershing *et al.* (Reports, 13 November 2015, p. 809) concluded that failure to account for temperature in the assessment and management of Gulf of Maine Atlantic cod caused overfishing. We argue that the "extra mortality" calculation driving this conclusion is an artifact. Environmental factors affect all stocks, but attribution of additional mortality to temperature alone by Pershing *et al.* is unsupported by the data.

Full text at http://dx.doi.org/10.1126/science.aad9674

Comment on "Slow adaptation in the face of rapid warming leads to collapse of the Gulf of Maine cod fishery"

Douglas P. Swain, Hugues P. Benoît, Sean P. Cox, Noel G. Cadigan

Pershing *et al.* (Reports, 13 November 2015, p. 809) concluded that recent warming in the Gulf of Maine contributed to the collapse of Gulf of Maine cod. We argue that this conclusion is based on a flawed analysis of the population dynamics of this cod stock. We believe that understanding the potential role of climate change in the collapse of this stock requires more defensible analyses.

Full text at http://dx.doi.org/10.1126/science.aad9346

Response to Comment on "Slow adaptation in the face of rapid warming leads to collapse of the Gulf of Maine cod fishery"

Andrew J. Pershing, Michael A. Alexander, Christina M. Hernandez, Lisa A. Kerr, Arnault Le Bris, Katherine E. Mills, Janet A. Nye, Nicholas R. Record, Hillary A. Scannell, James D. Scott, Graham D. Sherwood, Andrew C. Thomas

Palmer *et al.* and Swain *et al.* suggest that our "extra mortality" time series is spurious. In response, we show that including temperature-dependent mortality improves abundance estimates and that warming waters reduce growth rates in Gulf of Maine cod. Far from being spurious, temperature effects on this stock are clear, and continuing to ignore them puts the stock in jeopardy.

Full text at http://dx.doi.org/10.1126/science.aae0463

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